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A STUDY OF ULCER OF THE STOMACH AND DUODENUM.

BASED UPON A SERIES OF EIGHTY-TWO CASES.

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(From the Clinic of Professor Osler.)

It is only by a careful study of a series of cases of any one disease that a general and comprehensive picture of the condition can be obtained. Moreover, an analysis of the cases of "round ulcer" at the Johns Hopkins Hospital is of particular interest, as the disease has here been regarded as comparatively rare.

Etiology. *Incidence.* In the analysis ulcer of the duodenum has been included, as physiologically, clinically, and pathologically the first part of the duodenum is identical with the stomach.

In all, 82 cases of round ulcer have occurred in the medical, surgical, and gynecological services from the opening of the hospital on May 5, 1889, to May 1, 1904—a period of about fifteen years. There has been a total number of 44,338 admissions to these services, which gives for the hospital a frequency of 0.18 per cent. According to service, the admissions are: 17,043 medical, with 76 cases; 16,553 surgical, with 4 cases; 10,961 gynecological, with 2 cases.

The surgical series includes only cases that were admitted primarily into that service, and is exclusive of the 11 that were transferred from the medical side for operation.

In this series there were six* duodenal ulcers—four in the medical and one each in the surgical and gynecological services.

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* Since writing, the record of a subsequent admission of a supposed case has been found. The autopsy showed a ruptured œsophageal varix accompanying a cirrhosis of the liver to be the source of the hemorrhage. The local signs are difficult to explain, as no ulcer was found in the duodenum or stomach.

We have elsewhere* given comparative clinical data as to the frequency of ulcer (exclusive of duodenal) in some of the leading hospitals of Europe and America. We will recall some of the more striking figures: Edinburgh, 2.02 per cent.; Berlin, 1.33 per cent.; Boston, 1.28 per cent.; Montreal, 0.92 per cent.; London, 0.78 per cent.; New York, 0.44 per cent.; Baltimore, 0.37 per cent.; Denver, 0.12 per cent.

Hence we conclude that gastric ulcer is relatively rare in Baltimore.

SEX. The older writers state that ulcer of the stomach is more frequent in women, in the ratio of 2 to 1. Welch[1] found that in 1699 cases the ratio was 3 to 2. Mayo,[2] in the operating-room, found 59 per cent. in women and 41 per cent. in men. Greenough and Joslin[3] found in Boston a remarkably high ratio of females to males (5 to 1), "though no such disproportion exists in the total number of males and females admitted to the hospital." We could find only one higher ratio than the above, viz., 14 females to 1 male (quoted by Fiedler).

In our series there were 48 males to 28 females—a ratio of almost 2 to 1 in favor of the males. Now the ratio of total males to females for all services is 1 to 1, but 2 to 1 for the medical, from which the vast majority of our cases is taken. Hence it will be seen that gastric ulcer with us is *relatively* as common in men as in women, contrary to the usual idea.

Duodenal ulcer is more frequent in males. Osler[4] collected 178 males to 41 females—a ratio of more than 4 to 1. Mayo[2] found 20 males out of 24 cases at operation. In our series there were 5 males to 1 female—about the generally accepted proportion.

AGE. Most authorities, notably Welch in his classical monograph in Pepper's *System,* give the most frequent period for both sexes as between twenty to forty years; for the males, twenty to thirty years, and females, thirty to forty years. Greenough and Joslin's figures tally with this. Calwell,[5] in an analysis of 193 cases, found that in the male only 3 cases occurred before twenty-five years, while in the female there were no cases before thirteen, but the majority were between the ages of fifteen and twenty-five.

According to our table the larger number of all cases (32.9 per cent.) occurred between the ages of forty to fifty. In the males 41.5 per cent. occurred between the ages of forty to fifty—a decade later than usual; while in the females 44.8 per cent. occurred, as usual, in the third decade.

As one might expect, there were none in the first decade, and only 3 in the second, all of whom were girls. This rarity in early life is well recognized. Welch found only one instance of the disease in the first decade of life among the 607 cases which he collected. At the Baby's Hospital of New York there were only 5 cases in 390 autopsies. Fenwick,[6] in 1900, was able to collect from the literature only 18 cases in children. There were in our series 20 patients over fifty years of age—many of them coming under the category of "senile ulcer"—a condition often difficult to differentiate from carcinoma.

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* Medical News, 1904, vol. ii.

TABLE I.—SHOWING PROPORTION OF SEX AND AGE IN GASTRIC AND DUODENAL CASES.

Decades.	Total cases.	Per cent. of total.	Total males.	Per cent. of males.	Total females.	Per cent. of females.
1 to 9	0	0	0	0	0	0
10 " 19	3	3.6	0	0	3	10.3
20 " 29	17 (1 d.)	20.7	4	7.6	13 (1 d.)	44.8
30 " 39	15 (1 d.)	18.4	11 (1 d.)	20.7	4	13.9
40 " 49	27 (2 d.)	32.9	22 (2 d.)	41.5	5	17.2
50 " 59	14 (1 d.)	17.1	12 (1 d.)	22.6	2	6.9
60 " 69	5	6.1	3	5.7	2	6.9
70 " 79	1 (1 d.	1.2	1	1.9	0	0
.	82	100.0	53	100.0	29	100.0

CONJUGAL CONDITION plays no role in the male. Of the 29 women, 16 of them were nulliparæ, 5 primiparæ, and 8 multiparæ.

RACE. Of the 82 cases, 67 were white and 15 were colored—a ratio of 4.5 to 1. As regards admission, the ratio is 7 to 1. Therefore, among our cases ulcer is relatively more common in the colored race, which fact does away with a recent suggestion that the rarity of ulcer in Baltimore is due to the number of colored admissions. We could find no other figures on this point.

NATIONALITY. Fifty-eight of our series were born in various parts of the United States—16 in Germany, 3 in Russia, 2 each in Scotland and Ireland, and 1 in Switzerland. The relative proportion of American-born to German-born patients is 13.6 to 1, while in our series it is 3.6 to 1—*i. e.*, ulcer is relatively more frequent among the Germans. This bears out our figures on the relative incidence of ulcer in America, which show that on this continent the percentage is 0.57, as compared with 0.78 per cent. of London, and 1.33 per cent. of Berlin.

OCCUPATION. Much stress was formerly laid upon occupation as a predisposing cause. Greenough and Joslin could not find any one occupation especially prone to the disease; thus 66 per cent. of the females were housewives, while of 200 consecutive female admissions there were 71 per cent.; again, only 7 per cent. were cooks as compared with 4 per cent. of general admissions. In our series 12 of 29 females did housework (41 per cent.), and only 3 were cooks (10 per cent.). Of 53 males there were 9 laborers and 9 merchants—*i. e.*, 17 per cent. of the cases were divided equally between the upper and lower walks of life. Bramwell believes that ulcer is more common in the hospital class than in well-to-do patients —a point to which Robson rightly takes exception. Again, there were only 2 tailors and 1 shoemaker—occupations considered especially prone to the disease. The only part that occupation can play is that the in-door pursuit, on account of its sedentary nature, is more predisposing to ulcer than the out-door. Thus, in our series the proportion is nearly 4 to 1 (61 in-door to 14 out-door).

FAMILY HISTORY. Heredity plays little or no part. In 8 cases (9.7 per cent.) there was a history of stomach trouble other than cancer, but in none was there any special suggestion of ulcer. In another 8 cases there was a definite history of carcinoma twice of the stomach (2.4 per cent.). Statistics elsewhere are unsatisfactory, though Drechsfeld succeeded in eliciting a family history of ulcer in 8 cases.

PREVIOUS STOMACH TROUBLE. In 47 of the series (57.3 per cent.) there was a definite history of this for some months prior to the onset of symptoms suggestive of ulcer, though in many it was difficult to draw the line between the two. In the majority it was described as "indigestion," as shown by discomfort after certain articles of food, eructations of gas and pyrosis.

CHLOROSIS has been considered an important factor, especially among young females. Exact figures on this matter are difficult to obtain, though Osler states that "anæmia and chlorosis predispose strongly to gastric ulcer, particularly in women and in association with menstrual disorders." In 72 per cent. of Fenwick's series there was a definite history of chlorosis (pallor, œdema, and dyspnœa) before the first symptoms of ulcer were manifest. In only 9 of our cases (11 per cent.) was there a definite history of chlorosis.

TRAUMA. There was a positive history in 7 (8.5 per cent.). In 4 it was "direct violence," as a blow or fracture of ribs; in 1 "strain," and in 2 merely "injury." Burns may cause ulceration, but usually of the duodenum; of the latter there has not been an example in about 2300 autopsies at the Johns Hopkins Hospital.

ALCOHOL. In a large proportion (53.6 per cent.) there was a history of the use of alcohol, and in 19.5 per cent. to excess. How far this predisposes to ulcer it is difficult to say. Lancereaux thinks ulcer is more common in drunkards, especially those who drink ardent spirits. The weight of opinion regarding the "bodily ills" that are due to alcohol is at present turning the other way.

SYPHILIS. Syphilitic ulcer of the stomach is rare, and differs materially in its appearance and symptomatology from simple ulcer. We are not concerned with it in this paper. Nevertheless, in our series there was a definite history of syphilis—either recent or old—in 15.8 per cent Fenwick found such in 10 per cent. of the chronic cases. The etiological role that syphilis may play consists probably in the production of a specific endarteritis.

TUBERCULOSIS. In our series, which does not include specific tuberculous ulcers, tuberculosis in one or another of its manifestations was present in 13.4 per cent. of the cases, as shown post-mortem, or clinically by the sputum. Fenwick found such in 17 per cent. of his series There is no evidence in the literature that. tuberculosis predisposes to ulcer. In Brinton's opinion, however, ulcer of the stomach predisposes to tuberculosis. Welch[1] says: "The large share taken by pulmonary phthisis in deaths from all causes renders the disease a frequent associate of gastric ulcer. It is *probable* that the lowered vitality of phthisical patients increases somewhat the liability to gastric ulcer."

DISEASES OF THE HEART AND BLOODVESSELS. Arteriosclerosis may play some part, as it predisposes to thrombosis, which is undoubtedly of importance in the pathogenesis of round ulcer. It was present, as shown clinically by palpation of the peripheral vessels or post-mortem by macroscopic changes, in 48.8 per cent. of our series; to a marked degree in 22 per cent.

Endocarditis should also be considered, as it may give rise to embolism, which has been regarded by some as an important etiological event. Valvular disease of the heart was present, as shown by undoubted physical signs or at autopsy, in 8.5 per cent. No regard is taken of merely hæmic murmurs which were noted in 5 other cases.

SYMPTOMATOLOGY. *Complaints.* These were various, but in 50 per cent. "pain" was the chief complaint. In another, 47.5 per cent., "stomach trouble;" "dyspepsia" or "vomiting" were the symptoms from which they sought relief. In only 5 cases (6 per cent.) was a history of "vomiting of blood" volunteered by the patient.

MODE OF ONSET. There were only 8 cases (9.7 per cent.) that might be termed *acute*, of which two developed in the hospital during the course of another disease; 2 developed twenty-four hours before admission; 3 three weeks, and 1 four weeks before admission. The remaining 74 were examples of *chronic* "ulcer" having existed for periods ranging from two months to twenty years.

THE THREE CARDINAL SYMPTOMS. The order of frequency of these will be seen in Table II., where they are contrasted with those given by Greenough and Joslin,[3] and those of Fenwick. For comparison's sake we have also added those of Osler and McCrae[7] in their analysis of the carcinoma cases in this institution.

TABLE II.—FREQUENCY OF VOMITING, PAIN, ETC., IN GASTRIC ULCER.

Symptoms.	Johns Hopkins Hospital. (82 cases.)	Greenough and Joslin. (187 cases.)	Fenwick (chronic). (265 cases.)	Cancer series (J. H. H.) (150 cases.)
Vomiting . . .	85.3 per ct.	95.7 per ct.	72 per ct.	85.3 per ct.
Pain	82.9 "	92.5 "	100 "	86.6 "
Hæmatemesis . .	75.6 "	78.6 "	71 "	28.1 "
	Exclusive of melæna.	Exclusive of melæna.	Inclusive of melæna.	Exclusive of melæna.

By this it will be seen that the order of frequency in ours is similar to that of the Boston writers, though all three symptoms are somewhat more frequent in the latter. On the other hand, Fenwick's figures from London for 265 chronic cases are somewhat different, pain being present in 100 per cent.; while vomiting and hæmatemesis are of practically equal frequency, they are considerably less common than in either of the preceding series. The cancer figures are interesting, pain and vomiting being present in the vast majority, while hæmatemesis, as one might expect, is three times less frequent than in ulcer in our series.

PAIN. This symptom is usually the first indication of the existence of an ulcer, and is the most constant and distinctive feature. But pain is only a relative matter, and is the most difficult of all data to estimate. It was present in 82.9 per cent. of our cases. It usually means an active ulcer or its sequelæ. Leube believes that cicatrices cause pain only in very rare instances.

Site. Pain is usually referred to the epigastrium, as was the case in 54.4 per cent. of our series. Occasionally it is referred to the spine or left shoulder-blade (14.7 per cent.); more rarely to either hypochondrium (8.8 per cent.). In 2 cases the sternum and right iliac fossa were the respective locations. That the situation of the pain may give a clue to the site of the ulcer was maintained by Brinton. This is not accepted by the more recent authors. Of the 27 cases in which the site of the ulcer was determined at autopsy or exploratory operation, the site of pain was entirely misleading in 3 cases, of no definite value in 17, while in another 7 it only pointed to the pylorus or the duodenum.

Character. The pain is usually severe, though it may not exceed that of hyperchlorhydria. It is rarely continuous (4.8 per cent.), but if so usually means some complication as perigastric adhesions, localized peritonitis, or hyperchlorhydria. The *quality* of the pain is variously described as "sharp" (20.3 per cent.), "dull aching" (18.6 per cent.), "burning" (15.2 per cent.), "colicky" (13.5 per cent.), "gnawing or grinding" (11.9 per cent.), and as "boring," "cutting," "tearing," etc., in the remaining 22.5 per cent.

Pressure usually increases the pain, but may afford relief. The statements of different observers on this point are at great variance. In 24 cases where inquiry was made with regard to the question, increase of pain was present in 62.5 per cent., relief in 33.3 per cent., and no relief in 4.2 per cent. Again, pain is influenced by *posture.* Thus, out of 10 cases in which note is made of this, relief was experienced in 6 either by lateral or dorsal decubitus, "knee-and-chest" or upright position. Osborne's contention that the site of the ulcer may be inferred from the effect of posture on the pain, could only be tested in 2 cases, and without satisfactory result. In 1 case, where the ulcer involved the entire circumference of the pylorus, dorsal decubitus gave relief, while in a duodenal ulcer with stenosis either lateral posture was helpful.

The relation of pain to *ingestion of food* is important. It is usually increased by eating (39 per cent.), but may be relieved (14 per cent.), or, again, be entirely independent of food. Gerhardt maintains that patients who are afraid to eat because they *fear* pain are usually suffering from simple ulcer and not cancer. There was "no pain" in only 4 cases, though in another 10 no mention is made. Some have called attention to the fact that cases of ulcer of the stomach without pain represent a grave type of the disease. In our series of four, 3 died, 2 from hemorrhage and 1 from a complication. In Boston 3 of 14 cases without pain were fatal.

Vomiting is the commonest symptom in our series (85.3 per cent.). There is a close relation between the severity of the pain and the vomiting. In the majority (67.2 per cent.) it is frequent, occurring almost constantly in a few cases; in others periodically. It is usually involuntary, but in some it may be provoked for the relief it affords, as was the case in 3 of our series. Again, in a certain number of cases (20.7 per cent.) it is only "only occasional," following some particular paroxysm of pain or the ingestion of certain foods. In a small percentage (12) it is the exception, and not the rule. The *quantity* varies greatly, but is profuse only where there is either hypersecretion or pyloric obstruction. Emesis generally depends upon the *ingestion of food*, and occurs at the height of digestion or immediately after taking food into the stomach. This was the case in 14 out of 20 where this point was noted It usually affords relief (as was the case in 15 of our series) by removing the cause of irritation, viz., the food and acid-juice. In 7 cases there was an entire absence of vomiting. These merit a moment's consideration; 5 ran a moderate course, 1 being discharged well, and 4 improved; the other 2 were more severe, 1 dying in the hospital, and 1 four weeks after discharge. The autopsy on the former (Case 15), revealed a large eroding ulcer upon the lesser curvature and posterior wall near the pylorus, with erosion of the artery, perforation of the wall, and exposure of the pancreas beneath. This one case conflicts with the statement "that vomiting is never absent when an orifice of the stomach is involved."

Relation of Vomiting and Pain to the Site of the Ulcer. Of the 23 cases that came to autopsy or exploratory operation, the site of the ulcer is specified in 22. In ulcer of the pylorus vomiting was almost constant, as was also pain, although to a somewhat less extent. In involvement of the lesser curvature vomiting and pain were present in a third of the cases only. In 4 cases in which the posterior wall was also involved, vomiting was present in 3 and pain in all 4. In the 1 case, in which the anterior wall was also involved, both were present. In 4 cases with ulcer on the greater curvature involving either wall pain was present in three instances, vomiting in all. In 1 of the 2 cases in which the lesion was on the posterior wall alone, both were present. Thus, vomiting was present in 17 out of 22 cases, more constantly where either orifice or the greater curvature was involved than when the ulcer was on the lesser curvature. Pain, on the other hand, was practically constant except in ulcer of the pylorus or lesser curvature.

TABLE III.—RELATION OF VOMITING AND PAIN TO SITE OF ULCER.

Site of ulcer.	No. of cases.	Vomiting.	Pain.
Pylorus	8	7	5
Lesser curvature	3	1	1
Lesser curvature and posterior wall	4	3	4
Lesser curvature and anterior wall	1	1	1
Greater curvature (near cardia)	1	1	1
Greater curvature and posterior wall	1	1	...
Greater curvature and anterior wall	2	2	2
Posterior wall	2	1	1
	22	17	15

HÆMATEMESIS. Vomiting of blood is usually not so constant a symptom. It was, however, present in 75.6 per cent. of our series, as compared with 78.6 per cent. of the Boston cases. The older writers give a much lower frequency. Thus, Brinton, 28 per cent.; Müller, 32 per cent., and Gerhardt, 47 per cent.

The *color* is noted in 56 cases; "coffee-ground" in 66 per cent.; bright red in 33 per cent. "Coffee-ground" vomiting occurs whenever the blood remains sufficiently long in the stomach to be acted upon by the gastric juice, and does not necessarily imply malignancy. On the other hand, "bright blood" was present in 11 per cent. of the cancer series in which hæmatemesis occurred. The *quantity* was usually fairly large; in 86.1 per cent. it was more, and in 18.9 per cent. it was less than two drachms. Severe hemorrhage may cause instant death without external evidence. This "l'hémorragie foudroyante" occurs, according to Brinton, in 5 per cent., and Fenwick in 3.4 per cent. There was one example of this in our series (Case 65), in which an aneurysm of the thoracic aorta being present, its rupture was thought to be the source of hemorrhage, until the autopsy revealed an ulcer eroding the gastric artery. The *number* of the hemorrhages is also variable. Thus there were—

One hemorrhage	7 cases.
Two hemorrhages	7 "
Three hemorrhages	11 "
Four hemorrhages	1 case.
Many hemorrhages	15 cases.

In about 40 per cent. of Fenwick's cases it recurred in a week, in 73 per cent. in twelve months after its apparent cessation. The factor which determines the recurrence, Moynihan[8] thinks, is the stretching of the ulcer from distention of the stomach. This latter condition he found in all of 15 ulcer cases in which he operated for hemorrhage. Hæmatemesis sometimes gives almost immediate relief to the pain and vomiting. Of the 16 cases in which no hæmatemesis occurred ulcer was found in 5 at autopsy and 1 at operation; in the remaining 10 the diagnosis was supported by other data, such as melæna, local tenderness, vomiting, etc. As to the frequency of hæmatemesis at the menstrual period we have no data. In two of the Boston series the first hæmatemesis occurred at this time.

MELÆNA. Severe hemorrhage from an ulcer invariably gives rise to tarry stools, but, according to Hosslin, only when the blood amounts to 500 c.c. Melæna can occur without hæmatemesis in an ulcer near the pylorus or in the duodenum. In 55 cases in which there was a clear history as to its occurrence or non-occurrence melæna occurred in 80 per cent. The statements of patients are not reliable on this point, and often give one an altogether erroneous idea. There is no doubt that a careful, systematic, routine examination of the stools would reveal blood in the vast majority of cases.

The *color* was dark and tarry in 8 per cent., and bright red in 20 per cent. of 28 cases. The color varies, of course, according to the size, freshness, and rapidity of the hemorrhage and the length of time the blood takes to pass through the intestinal tract. The *quantity* was large in 9, small in 6. The *number* of times in which melæna was observed varied from a few in 17 to many in 10.

Of the 44 positive cases, 36 accompanied or followed the vomiting of blood; 8 gave no history of hæmatemesis; 1 of these was regarded as duodenal, and 5 were considered gastric ulcer; 2 were shown at autopsy to be gastric ulcer.

NAUSEA was present in 32 out of 34 cases. That this symptom was not noted in the remaining 50 cases suggests that it is relatively uncommon. This is natural, for the vomiting is a result of the pain and a desire on the part of the patient or his stomach to be rid of irritating material. A recent writer[9] says: "A feature to be remembered about the vomiting is that it is not usually accompanied by nausea, and does not require much effort."

DYSPEPSIA. By this term we include discomfort after eating, eructations, pyrosis, headache, palpitation, meteorism, etc. It was present in 96 per cent. of 52 cases. It is of little or no importance, and generally dependent upon the attendant hyperchlorhydria and chronic gastritis, both of which usually accompany the disease. Digestion, then, is not, as a rule, more difficult or restricted in uncomplicated cases.

APPETITE. This may be lost (5.9 per cent.), variable (4.4 per cent.), poor (45.6 per cent.), or good (44.1 per cent.). Others have found that as a general rule the appetite is good. The dictum that in ulcer the appetite is good, but patients *fear* to eat, while in cancer the appetite is lost, is an important aid to diagnosis.

Bowels. Constipation is the rule, as was the case in 61.6 per cent. here and 80 per cent. in Boston. Greenough and Joslin ascribe their large percentage to the greater frequency of the disease in women. The latter was not the case in our series, which may account for the lower percentage in which constipation was present. The most important cause is the small amount of solid food taken and retained by the patient. In 10.9 per cent. there was "looseness" if not actual diarrhœa. In the remaining 27.5 per cent. the bowels were regular.

General Health. The usual teaching that moderate loss of weight and strength are present is not borne out. In none was cachexia noted, but in a very large number was there loss of strength (98 per cent. of 47 cases) and loss of weight (87 per cent. of 62 cases) noted. These are due partly to the pain and inability to eat, and partly to the loss of blood. I think the number of cases (87.1 per cent.) in which loss of weight occurred is of interest. The details are given in Table IV.

Loss of weight (no figures)	15		
Slight (1–5 lbs.)	1	10–20 lbs.	10
Moderate (5–10 lbs.)	2	20–30 lbs.	7
Marked (10 lbs. or more)	36	30–40 lbs.	10
		40 + lbs.	9
	54		36

Of the 9 that lost forty pounds or over, there were 3 that lost forty pounds; 2, forty to fifty pounds; 2, forty-six pounds; 1, fifty pounds, and 1, seventy-five pounds. Such a marked loss of weight would naturally suggest malignant disease, but it must be borne in mind that pain, coffee-ground vomitus, tumor, and marked loss in weight can all be present in benign ulcer of the stomach.

Physical Signs. *Tenderness* is the least important of the cardinal symptoms or signs. Its absence or presence is responsible for many errors in diagnosis. It was noted in 57.9 per cent. of our series as compared with 69.5 per cent. in Boston. The *degree* varied from one extreme to another; thus, 2 cases could not bear the pressure of the clothing, while in others considerable pressure was required to elicit any discomfort.

Site. It was usually localized to a small area in the epigastrium (75 per cent.), but in others it was general over the upper abdominal zone. It was present in the left hypochondrium (10 per cent.); in the right hypochondrium (5 per cent.); right iliac fossa (5 per cent.), and in umbilical zone (5 per cent.). The *tenderness in back* (Druckschmerz), which, according to Boas, is present in 30 per cent., has not been sufficiently tested in this hospital to warrant any conclusions.

Presence of Resistance or Mass. Out of 70 cases where this point is noted a mass was present in 20 per cent. and resistance in 14.2 per cent. The mass was in the right hypochondrium (36 per cent.), epigastrium (29 per cent.), greater curvature (14 per cent.), pylorus (14 per cent.), and left hypochondrium (7 per cent.). The presence of a mass is often misleading, but the possibility of such, while not so frequent as in carcinoma, should always be kept in mind. In Osler and McCrae's[7] series of cases it was noted in 76.6 per cent.—only about three and one-half times more frequent than in our series. Reinhard has reported 16 cases with tumor in which simple ulcer was found at autopsy. The Mayos[2] have seen at operation 6 cases with tumor due to thickening about a chronic ulcer. Moynihan[8] in 100 gastroenterostomies for ulcer, found 10 cases with a tumor, 2 of which were thought to be malignant until the exploratory operation and subsequent course pointed to their benign nature. Gerhardt has described four conditions in which a mass may be present in a simple ulcer, viz.: 1. The thickened base and hard margin of the ulcer itself. 2. Functional hypertrophy of the musculature. 3. Localized exudate or abscess from perforation. 4. Adhesions between neighboring organs. There were examples of the three latter in our series. One case has been reported in detail by Osler[10] (Case 12) on account of the "prominent tumor at the pylorus, which relaxes and contracts and appears and disappears beneath the skin, due to the hypertrophied pyloric musculature."

Dilatation of the Stomach. This was present clinically in 18 out of 52 cases (34.6 per cent.); an absence of comment in the remaining 30 cases would warrant assuming the absence of dilatation. Therefore, a percentage of 22 would seem a fairer figure. As to the *degree*, it was marked in 7, moderate in 5, slight in 2, and not specified in 4. In the cancer series it was present in 42 out of 150 cases (21.3 per cent.). Broadbent has pointed out that extreme dilatation from carcinoma is rare. Osler and McCrae refute this, as they found a much larger number of cases of dilatation of the stomach due to malignant disease than any other single cause. Our figures place simple ulcer as *relatively* as frequent a cause, but on account of the greater prevalence of cancer in the Johns Hopkins Hospital, malignant disease would still take pre-eminence as a cause of gastrectasis. Dilatation in an ulcer signifies pyloric obstruction either directly from the ulcer, or scar, or perigastric adhesions, or indirectly from contraction or spasm of the pylorus from mechanical irritation. It must be remembered that there may be mechanical obstruction from contraction or spasm caused by a pyloric ulcer, *without* dilatation of the stomach (Hartmann's syndrome). The dilatation was determined by the tartaric acid and soda bicarbonate method *without* any harmful results. Hockman, however, has reported deaths from sudden distention of the stomach.

Gastric Analysis. The value of an elaborate analysis of the gastric juice is much exaggerated. We quite agree with Mayo that the hydrochloric acid determination is the only one of value, and would add that *too much* importance cannot be attached to it. The Ewald-Boas breakfast is the one in vogue in this institution as elsewhere in America. The objection that exists in England to the use of the stomach tube in ulcer of the stomach does not prevail here. Unless there was a recent history of hemorrhage a test breakfast was given, and without any ill effects. To 53 patients a breakfast was given, and in only 1 case was a Riegel meal employed. Only 1 patient refused to submit. Of the 54 cases, no contents were recovered in 2. Analysis from one or more breakfasts was made in 52 patients; thus, 29 had one meal, 14 two meals, 5 three meals, 3 four meals, 1 six meals. Let us examine the results in detail.

Total Amount. Assuming that 40 to 50 c.c. be normal residue in one hour for the Ewald-Boas breakfast, and 300 to 350 c.c. at the end of two to three hours for the Riegel meal, there were 46 cases in which no figures were given, 54 per cent. above and 17 per cent. below normal, while the remaining 29 per cent. were within the limits of normal. It is interesting to note that many cases of Reichman's disease, where hypersecretion exists to an extreme degree, have been recently shown to be due to old cicatricial stenosis of the pylorus or duodenum.

Total Acidity. If we assume that normally after an Ewald test breakfast from 40 to 60 c.c. of decinormal sodium hydrate solution are required to neutralize 100 c.c. of filtered gastric contents, 27.5 per cent. of the cases showed hyperacidity, 42.5 subacidity, while the remaining 30 per cent. were within normal limits.

Free Hydrochloric Acid. This was tested qualitatively by Günzburg's reagent, and was found present in 82 per cent., and absent in only 18 per cent. of the cases. In 34 cases the quantity was estimated by tritration with dimethyl-amido-azo-benzol as indicator, which is undoubtedly less accurate than tropaolin. There was hyperchlorhydria in only 17.6 per cent.; the quantity of HCl was within normal limits in 26.4 per cent.; there was hypochlorhydria in 26.4 per cent.; in 1 case the free HCl was normal once, and below normal on the next examination. This is, however, in marked contrast with the results in our cancer series, where free HCl was absent in 92 per cent. These figures are rather contrary to the generally accepted statement that hyperchlorhydria is present in 75 to 80 per cent. of cases, as is held by Riegel and many others. Mayo[2] in a recent paper says "two facts are prominent, first, that 75 per cent. of gastric ulcers lie in the grinding apparatus of the pyloric end, and, second, that sometime in the history of gastric ulcer, and in the majority of cases at all times, there is a relative increase in the secretion of HCl, and, whether cause or effect, this excess is a most important etiological factor."

We repeat, our figures do not bear this out, nor have Ewald, Gerhardt, or Drechsfeld found such to be the case.

Lactic Acid. This was tested for in 43 of the cases, and was found present in 6 (14 per cent.), doubtful in 3 (7 per cent.), and negative in 34 (79 per cent.). In these 9 cases there was dilatation of the stomach in 4, subacidity without evident dilatation in 2, and neither dilatation nor subacidity in 3. In every case Uffelmann's reagent was used, but in only 2 was the juice previously extracted with ether. Let us glance at a brief summary of these 9 cases.

(*a*) *Positive Cases.* 1. Case 6.[28] Pyloric stenosis (cicatrix of ulcer); female, aged twenty-two years, colored, washerwoman; hospital No. 5646; admitted July 29, 1892. Absence of previous dyspepsia; sharp onset of symptoms of pyloric stenosis; marked emaciation; palpable tumor; dilatation of stomach with stagnation; test for lactic acid very positive on four occasions; that on August 22d, after daily lavage, showed lactic acid with absence of free hydrochloric. Operation; death; autopsy.

This case has been criticised by Boas as probably one of ulcus carcinomatosum. There can be no ground for this objection, as a careful gross and microscopic examination of the tissues was made. Dr. Thayer tells me, however, that the stomach was not washed out before each test breakfast as a preliminary precaution.

2. Case 15. Ulcer of the stomach; perforation with local peritonitis; hemorrhage. Male, aged forty-five years, piano-tuner; hospital No. 9473; admitted March 22, 1894. History of dyspepsia for six months, vomiting, but no hæmatemesis; marked loss of weight. No dilatation of stomach. Analysis of test breakfast on 23d instant showed no free HCl and no lactic acid, but vomitus of same date contained a faint trace. Readmitted on June 16, 1894, with a recent history of hæmatemesis. Test breakfast without previous lavage showed stagnation; faint HCl, and presence of lactic acid. Diagnosis on both admissions: cancer of stomach. Readmitted September 11, 1894, in a very grave condition; sudden death; autopsy.

3. Case 19. Gastric ulcer. Male, aged forty-eight years, cabinetmaker; hospital No. 11,250; admitted October 27, 1894. History of ulcer for four years. No dilatation of stomach. Test meals on the 29th and 30th show presence of HCl and also of lactic acid; latter disappeared two days later, though there was no note of gastric lavage; slight stagnation.

4. Case 34. Gastric ulcer. Male, aged forty-eight years; traveller; hospital No. 17,089. Admitted August 24, 1896. History of ulcer for twelve years. Test meal and specimen of vomitus give very slight reaction to free HCl and lactic acid. Stagnation slight. No note of previous lavage and no dilatation.

5. Case 36. Gastric ulcer. Male, aged forty-five years, laborer; hospital No. 18,427; admitted January 27, 1896. Ulcer history for two years; slight dilatation of stomach; only one test meal given,

which showed free HCl and slight reaction for lactic acid. Stagnation evident. No lavage. Discharged well.

6. Case 56. Cirrhosis of liver; cholelithiasis; ulcer of stomach. Female, aged forty-two years, laundress; hospital No. 31,023. Admitted June 27, 1900. History of cirrhosis of liver and alcoholic neuritis. No definite history of ulcer. Two test meals *after lavage* on previous night showed presence of blood and a definite reaction for lactic acid in ethereal extract. Readmitted on September 17, 1900, deeply jaundiced and comatose. No test meal. Death; autopsy.

(*b*) *Doubtful Cases.* 1. Case 10. Gastric ulcer. Male, aged thirty-seven years, oysterman; hospital No. 7743. Admitted July 20, 1893. History of ulcer for eight years; test breakfast on 21st showed free HCl and no lactic acid, but on the 25th instant good free HCl and a small amount of lactic acid. No note of lavage or dilatation. Discharged.

2. Case 30. Gastric ulcer. Aged thirty years, teacher; hospital No. 14,899. Admitted July 4, 1896. Ulcer history for two years; test meal on the 7th showed free HCl and a faint lactic acid reaction. No lavage and no dilatation. Discharged.

3. Case 54. Pyloric stenosis. Dilatation of stomach. Male, aged thirty-eight years, warehouseman; hospital No. 28,202. Admitted October 21, 1899. History of ulcer for nine months and stenosis for four; after previous lavage, on the 23d, there was no free HCl and a "suspicion of lactic acid," but on the 27th free HCl was found and no lactic acid. In spite of daily lavage, on November 7th and again on December 7th there was noted a suspicion of lactic acid and absence of free HCl. Operation; death; autopsy.

Hence it will be seen that in spite of gastric lavage before the test breakfast lactic acid was present in 2 cases—once on six occasions and once in small quantities on three occasions. In 3 of the cases daily lavage was performed without a disappearance of the lactic acid. In the other 4 cases there was no lavage instituted either before the meal or at regular intervals. We believe that the presence of the acid in these cases is due to stagnation of the gastric contents and a consequent fermentation, and in those 2 cases which still showed lactic acid, though after the prolonged use of lavage, the stagnation of even twenty-four hours was sufficient to account for the acid. Unfortunately we have no case illustrating the disappearance of the lactic acid with the relief of the stagnation by a more frequent use of the stomach tube. Lactic acid was present in 75.3 per cent. of the cancer series as contrasted with 14 per cent of our cases.

Blood was noted macroscopically in 18 out of 33 cases—in large amounts in 2, in small amounts in 7, in traces only in 2. In another 5 it was found microscopically alone. Thus, blood was present in 57.5 per cent. as compared with 26.6 per cent. of the cancer series.

Microscopic examination was recorded in 33 cases. It was negative in 18 instances. Red blood corpuscles were found in 8, red blood corpuscles and "bacteria" in 3, and bacilli in 4. The latter were in each case thought to be Oppler-Boas bacilli.

THE BLOOD. The alterations in the blood are those seen in any secondary anæmia due to hemorrhage—*i. e.*, of the chlorotic type. Rencki,[11] in 1901, after a careful study of the blood in 15 cases of cancer and 14 of ulcer, concluded that no characteristic differences could be made out between the anæmias of the two, and that examination of the blood is of very little value from a diagnostic point of view.

Red Blood Corpuscles. The red blood corpuscles were counted in 44 of our cases. The highest count was 6,784,000, the lowest 1,012,000, and the average of sixty-seven counts was 4,071,000 per c.mm. The highest count occurred in a patient (Case 67), who had almost constant vomiting, for which she was on rectal feeding for some time; the resulting concentration of the blood was the probable cause of the polycythæmia. The lowest count was in a case (Case 15) which was regarded on two previous admissions as cancer; indeed, it was not until the autopsy after the third admission that the true nature of the case was discovered. Where anæmia occurred it was due to hæmatemesis. In 1 case there was a difference of 4,332,000 per c.mm. between the count of the first and that of the third admission after a series of hemorrhages. There were 10 cases in which the red corpuscles were below 3,000,000, and 2 in which they were between 3,000,000 and 3,500,000 per c.mm. Osler quotes a case of duodenal ulcer with hemorrhage in which the red cells fell to 700,000 per c.mm. The average red count in Cabot's[12] series (51) was 3,372,000 per c.mm.; he states that "there is no single disease in which the red blood cells are apt to be so low, with the exception of pernicious anæmia." Greenough and Joslin report counts in 43 of their series, and in only 24 was the red count below 4,000,000 per c.mm. Grawitz suggests that the ulcerative process itself, *without* hemorrhage, may cause actual anæmia, but Cabot believes that it is uncommon to see marked anæmia in patients who have never had hæmatemesis.

White Blood Corpuscles. These were counted in 54 cases. The highest was 40,000, the lowest 1100 per c.mm.; the average of sixty-three counts was 7500 per c.mm. The leukocytosis of 40,000 (Case 15) is difficult to explain, unless it was due to the recent hemorrhage. Leukocytosis does occur under these circumstances, though usually to a less marked degree. Unfortunately there were no differential counts in our series. Digestive leukocytosis was tested for in 5 cases and was present in all, though never to a marked extent. The highest count was 10,500 per c.mm. The digestive leukocytosis is of very doubtful value in differentiating ulcer from cancer of the stomach, as has been pointed out by Osler and

McCrae, and later by Rencki. The former found it present in 10 and absent in 12 of their cancer series.

Hæmoglobin. This was estimated in 44 cases. The highest was 105 per cent., the lowest 12 per cent.; the average of sixty-two estimations was 58 per cent. The greatest variation in any one admission (Case 15) was 36 per cent. Cabot found the hæmoglobin reduced to a point below 50 per cent. in 80 per cent. of his cases. The average color index was 0.72, as compared with 0.67 of Greenough and Joslin. In the cancer series the average percentage of hæmoglobin was lower, being 49.9 per cent., while the color-index was 0.63. Hence the blood picture is that of a secondary or chlorotic anæmia, as seen from the following average determinations: red blood corpuscles, 4,071,000; white blood corpuscles, 7500; hæmoglobin, 58 per cent.

URINE. The pathological changes in the urine are not striking, and are usually accidental. Quincke says the urine is pale, abundant, and sometimes contains albumin. Albumin and casts were present in 15 of our series; a trace of albumin in 7. In 55 the urine was negative. In no case was there a quantitative estimation of the chlorides. Drechsfeld says the chlorides are often diminished and the phosphates increased. If dilatation be marked and fermentation increased there may be an excess of ethereal salts and indican. Acetone and diacetic acid were not noted.

FEVER. This was present in 30 per cent. of our series. It did not exceed a degree or a degree and a half except in 6 cases. In 2 of these it was continuous, the ulcer being a complication of typhoid fever and pneumococcic septicæmia, respectively. In 4 other cases there was irregular fever, associated in three instances with complications—general peritonitis, tuberculosis, pyloric stenosis.

COMPLICATIONS. *Pyloric Obstruction.* Of the 76 cases of gastric ulcer there were 5 with definite pyloric obstruction and 1 doubtful case; 4 of these were confirmed at autopsy. There were also 2 cases of duodenal stenosis, both of which were confirmed at autopsy or operation. This gives 8 cases (9.7 per cent.) of obstruction from ulcer or its scar. There were in addition 10 other cases in which clinically the stomach was dilated, but no definite obstruction to its outlet was thought to exist. At autopsy the stomach was found dilated in 5 of these.

Deaths from Hemorrhage. Hemorrhage was the cause of death in 7 cases (8.5 per cent.), 1 of which was a duodenal ulcer. Of these, 4 were males and 3 females—*i. e.*, there was fatal hemorrhage from gastric ulcer in 4 out of 48 males (8.3 per cent.), and 2 out of 28 females (7.1 per cent.), the third case above mentioned having been one of duodenal ulcer. Our figures bear out the usual statement that hemorrhage is more fatal in the male than in the female. In the Boston series there were 5 males to 2 females. The ages of the males were forty-three, forty-five, forty-nine, and sixty-six, or an average of 50.7 years; the ages of the females were ten and fifty, an average of thirty years. The case in which fatal hemorrhage occurred from a duodenal ulcer was in a girl, aged twenty-one years. That hemorrhage is relatively more fatal in the young female cannot be deduced from 2 cases. Hood, of London, in a period of twenty years at Guy's Hospital, found no case of fatal hemorrahge in a young woman. The latter is also supported by the Boston writers.

In all 7 cases the bleeding point was found at autopsy. In 2 other cases of gastric ulcer and 1 other of duodenal there was a profuse terminal hemorrhage with the gastrointestinal tract filled with blood, but no sign of a bleeding vessel was found.

Opinion as to the frequency of fatal hemorrhage is at great variance. Mayo Robson[13] says it is a very serious and common accident occurring in 7 per cent. Byrom Bramwell,[14] in his controversy with Robson on this point, stated that he had only 2 cases in his hospital or private practice in a series of 127 cases (1.57 per cent.), and was able to find only an incidence of 0.67 per cent. in the Edinburgh Royal Infirmary and 0.84 per cent. in St. Thomas' (London). Welch says it is the cause of death in from 3 to 5 per cent. The other authorities in numerical order are: Müller, 11 per cent.; Rodman, 8 per cent.; Steiner, 6.3 per cent.; Brinton and Debove, 5 per cent.; Drechsfeld, 3.5 per cent.; Lebert, 3 per cent.; Schulz, 1.7 per cent. The fatal nature of the hemorrhage depends upon the fact that the ulcer makes a lateral opening into the vessel, which prevents natural hæmostasis by the retraction and contraction of the artery. It is impossible to correctly estimate the size of the perforated vessel from the amount of blood or the length of survival of the patient. Robson[13] states that "capillary hemorrhage may be so free as to simulate rupture of a large vessel, yet after death a careful examination may fail to discover any gross vascular lesion. Dieulafoy has pointed out that severe hemorrhage may occur as the result of a "pore-like erosion" of the wall of one of the large branches of the gastric arteries without any marked ulceration of the surrounding mucous membrane, or, at most, accompanied by an abrasion so slight in degree that even at postmortem the lesion may be overlooked (exulceratio simplex).

Hemorrhage may be capillary, venous, or arterial. The latter is the most common. Thus, Savariand, in a series of 54 cases, found ulceration of the splenic artery in 17, of the coronary in 6, pancreaticoduodenal, 7; gastric arterioles, 10; branches of the coronary vein, 2; other veins, 2; vessel not determined, 10.

In our series hemorrhage was from an erosion of a vessel in 6 gastric ulcers and 1 duodenal. In Case 15 the splenic artery was eroded, in another the arteria corona dextra, while in the remaining 5 it was a small arteriole or vein.

As to the *percentage of deaths* in gastric ulcer that are due to hemorrhage, Bramwell gives 9.3 per cent.; Fenwick, 16 per cent.; Cordui, 20 per cent., and Welch, 27 per cent.

Exclusive of the 3 cases in which no bleeding point could be found, and in which hemorrhage was not absolutely proven to be the cause of death, there were 7 out of 24 deaths (29.2) due to hemorrhage.

PERFORATION. (*a*) *With General Peritonitis.* Only 1 case occurred in our series of 82 ulcers (1.2 per cent.), which is a remarkable fact when one considers that there have been somewhat more than 47,000 admissions in the past fifteen years to all services. The history of this case in brief is:

Case 40. Male, aged fifty-eight years, colored; hospital No. 19,664; admitted June 8, 1897, complaining of pain and vomiting; gastric symptoms for one year; acute onset four days before admission, with pain in upper abdomen and vomiting. No hæmatemesis and no melæna; great weakness and emaciation; collapse; signs of general peritonitis on admission; temperature, 100° to 103°; pulse, 120 to 132; respirations, 36 to 48. The case was considered inoperable by the surgeon, but after twelve hours there was some improvement and an exploratory laparotomy was performed. General peritonitis was present, and a small ulcer on the anterior wall of the pylorus was found, through which the gastric contents were exuding; the patient's condition was so bad that nothing further could be done, and death ensued shortly after the patient left the table. Only a partial autopsy was permitted, which revealed in addition to the perforated ulcer a small scar in its neighborhood.

(*b*) *With Localized Peritonitis.* There are two examples of this: one (Case 15) showed perforation through the posterior wall with localized abscess between the pancreas and the left lobe of the liver, evidently a gradual process of considerable duration. The second (Case 65) showed perforation of the posterior wall into the pancreas, which was considerably eroded and firmly adherent to the stomach. Including these 2 cases there was perforation of the ulcer in 3 out of 82 cases (3.6 per cent.), in 3 out of 24 deaths (12.4 per cent.). There was no case of perforation of a duodenal ulcer.

Greenough and Joslin found perforation in 3.2 per cent. in Boston. Pathological statistics exaggerate the frequency of perforation. The only trustworthy method is to observe the number of times that perforation occurred in a large series of clinical cases. Lebert found 3.5 per cent. of 252 cases; Fenwick, in 5.5 per cent. of 265 cases. Brunner has recently analyzed 380 gastric and 86 duodenal perforations, which have been reported between 1893 and 1903. He found that the accident occurs in about 2 to 4 per cent. of cases; it is more common in the gastric ulcer in England, and the duodenal in America. Only one instance was on record of perforation while the patient was at rest in bed under medical treatment; in another case it followed gastroenterostomy. Perforation is possible in any situation in which ulcer may form, but is more frequent in the anterior wall near the pylorus and lesser curvature, or in the anterior wall of the upper horizontal portion of the duodenum. There is a certain small number of cases (7.5 per cent. of gastric and 20 per cent. of duodenal) in which perforation occurs without a previous history of ulcer. Brunner considers a diminution in liver dulness unassociated with tympanites characteristic of perforation of an ulcer; also that the site of pain is usually localized to the left of the median line in gastric and to the right in duodenal ulcer, and, further, that the area of tenderness in duodenal ulcer is not in the locality of the pain, but in the right iliac fossa.

Recovery from acute general peritonitis following perforation of a gastric ulcer may occur spontaneously. There are eight examples in literature.

Parotitis occurred in 1 case (1.2 per cent.), which has been reported in detail by Dr. A. Duval Atkinson.[17] A brief summary is as follows:

Case 29. L. P., female, aged thirty-five years; hospital No. 14,749; housemaid; admitted December 16, 1895, complaining of vertigo and general weakness. Family and personal history negative. For the past year has not been well, having continual pain in epigastrium, for one month, and amenorrhœa, for four months. On December 9th she took to bed because of gnawing sensation in epigastrium and nausea, and moderate hæmatemesis; latter was repeated in four hours, and was followed by extreme weakness. Examination on admission showed pallor of skin and mucous membranes; slight increase in cardiac dulness and a mitral systolic murmur; abdomen negative. Red blood corpuscles, 2,214,000; white blood corpuscles, 8000; hæmoglobin, 30 per cent. Urine had a specific gravity of 1010 to 1006, trace of albumin, and granular and hyaline casts. On December 16th there were pain and swelling of the left parotid, which by the next day had extended above the zygoma and far behind the mastoid, with infiltration of the side of the neck; locally redness, heat, and tenseness. On incision creamy pus exuded, which in cover-slips and cultures showed streptococci. No change in local condition, but patient gradually sank, and died on the 24th instant. There was no autopsy permitted.

This is not a very rare complication. Thus, Stephen Paget[18] reported 2 cases in 1897, and Hone[19] in the same year collected 8 cases from the literature and added 1 of his own. The latter was in a female, aged thirty-nine years, with a history of gastric ulcer for six years, with repeated hæmatemesis, who developed a double parotitis with little suppuration. Death; no autopsy permitted. This condition in ulcer is analogous to that found in injuries and diseases of the peritoneum, generative and abdominal organs. Some consider it more frequent in cases on rectal alimentation, which is denied by Hone, who considers that hæmatemesis is a predisposing factor.

Tetany. We have only one illustration of this, which, though not recognized at the time, was probably tetany. It occurred in Case 29, reported above. This patient gave a history of "cramps" in the legs for one year, of the utmost severity, being of a shooting, darting character, coming on in paroxysms, and lasting several minutes. At the height of these pains a feeling of "pins and needles" would be felt in the hands and fingers. There was no evident gastric dilatation. It must be borne in mind that the milder grades of tetany may be overlooked entirely, such as muscular cramps and pricking in the extremities without typical contractures. When severe, tetany usually terminates fatally. Thus, Hochnard reported 10 deaths in 11 cases and Albu 31 out of 40.

Ulcus Carcinomatosum. There are 3 cases in this series in which cancer was supposed to have developed upon a pre-existing ulcer. Two of these (1 and 2) are very doubtful, and though diagnosed by the resident physician "carcinoma of the stomach (post-ulco)," they were considered merely cancer by Dr. Osler in his series. The history of these cases in detail is:

1. Case 26. Female, aged sixty years; hospital No. 12,287; admitted March 19, 1895, complaining of indigestion. For past year abdominal pain, worse after food and at night; vomiting of small amounts; hæmatemesis for two or three days one year ago; occasionally melæna; appetite good; bowels constipated; loss of weight. No tenderness, but mass to right of umbilicus; marked dilatation of stomach; analysis showed free HCl and total acidity of 77; discharged much improved.

2. Case 39. Male, aged forty-seven years, German, shoemaker; hospital No. 18,818; admitted March 6, 1897, complaining of "indigestion" for six years, and "vomiting," burning pain in perigastrium after meals, relieved by "knee-chest" posture; vomiting for four months, at first slight, now frequent, and large in amount. One attack of hæmatemesis four to five months ago, when on four or five occasions he vomited dark lumps of blood; loss of thirty-three pounds in weight; no tenderness; no mass; marked dilatation of stomach. Analysis gave a trace of free HCl and no lactic acid; hæmoglobin, 65 per cent.; red blood corpuscles, 6,120,000; white blood corpuscles, 8000. Patient discharged improved.

3. Case 64. Male, aged fifty-five years, colored, oyster shucker; hospital No. 33,849; admitted February 13, 1901. Patient was unconscious, and the history elicited from his wife did not point to the stomach. He died from a pneumococcus septicæmia, and at autopsy an old round ulcer was found on the lesser curvature of the stomach 7 cm. from the pylorus. Microscopic sections showed "in the depth of tissues glandular structures, in which epithelial cells are actually invading the surrounding tissue. This invasion is also to be seen

in the mucosa immediately adjacent to the ulcer." At first a diagnosis of "gastric ulcer with beginning carcinomatous change" was made, but Dr. McCallum, the resident pathologist, on re-examining the sections thought "that the slight new-growth of epithelium present is not more than might be accounted for in the regeneration process in the healing of the ulcer." There were no metastases or invasion of the surrounding tissue.

4. (This case was not included in our series, through an oversight.) Male, aged forty-nine years, painter; hospital No. 44,935; admitted December 7, 1903, for "stomach trouble." Past history negative except for syphilis in 1880. Present illness began three years ago with "heartburn" and acid eructation. In June, 1901, a profuse hæmatemesis from which he fainted, followed by tarry stools; frequent vomiting since onset, often very profuse; appetite good until nine months ago, when he gradually gave up solid food because of pain; loss of fifteen pounds in weight during the past five weeks; no emaciation or cachexia. Local tenderness in epigastrium; active visible peristalsis and marked dilatation of stomach; firm, nodular mass to right of mid-line and 3 cm. above umbilicus. Hæmoglobin, 45 per cent.; red blood corpuscles, 3,004,000; white blood corpuscles, 15,200. Test breakfast showed marked hypersecretion and hyperchlorhydria (100.5), with blood-streaked mucus. The hyperchlorhydria practically decreased with gastric lavage, until by December 18th there was a marked subacidity. There was always a morning residue of 400 to 2000 c.c. The general condition improved; there was a gain of two pounds in weight, and the blood rose to 60 per cent. hæmoglobin and 4,000,000 red blood corpuscles. The patient was transferred to the surgical side, and an operation was performed December 30, 1903. At the exploratory operation there was marked dilatation of the stomach, with a mass surrounding the upper two-thirds of the pylorus. Several large, hard glands were found, one of which was very suspicious on section. The mass itself was thought to be carcinoma, which was afterward confirmed by the pathologist. Pylorectomy with gastrojejunostomy was done. The patient made an uninterrupted recovery, and when last heard from, six months ago, was doing well.

Let us consider the pros and cons in these 4 cases. In the first there is no definite ground for the supposition of a pre-existing ulcer; as the onset with hæmatemesis one year before is not against a beginning cancer. In the second, the history of "indigestion" for six years *suggests* the possibility of ulcer, but the recentness of the hæmatemesis (fifteen months) and the vomiting (four months) all point to a developing carcinoma. In the third case we have no previous history to aid us, and the most we can say is that there was an old ulcer which might have developed into cancer if the patient had survived, but was not definitely malignant at the time of his death. The fourth case is undoubtedly one of carcinoma, which, from the preceding history, probably developed upon an old ulcer, though from the size and character of the mass the early symptoms might have been due to a slow growing scirrhus cancer.

Hence in our series there are only 3 out of 82, or, better, 4 out of 83 cases (4.8 per cent.) in which there is any reasonable possibility of a simple ulcer having developed into a malignant one. Fenwick found only 2 out of 89 ulcer cases (2.2 per cent.) which showed evidence of malignancy. Contrary to our belief, there are many who consider that a large proportion of cancers of the stomach develop from a pre-existing benign ulcer. Riegel believes it to be a frequent occurrence, while Zenker maintains that the majority of carcinomata originate from ulcer. According to Lebert 9 out of every 100 cases of carcinoma of the stomach are due to ulcer. Graham,[2] Mayo's associate, found in 135 cases of cancer an ulcer history in 60 per cent. Rosenheim found such a history in only 6 per cent. of the cancer cases, and Barling and Hirschfeld in but 5 per cent.

Sticker pointed out that in those rare cases of carcinoma in which free hydrochloric acid persisted the origin was in a benign ulcer.

ASSOCIATED CONDITIONS. These are numerous. Tuberculosis occurred in 4 cases; in two the involvement was of the peritoneum and lungs, and in two general. Cirrhosis of the liver was present in 3 cases and obscured the clinical diagnosis, the hæmatemesis being ascribed to a ruptured varix. Jaundice was present in 2 cases from involvement of the gall-ducts in adhesions: in 2 further cases gallstones were found. It is interesting to note that Case 75 was at first thought by the family physician to be one of gallstones on account of the site of the pain; the subsequent diagnosis, however, was cicatricial stenosis of the pylorus. At the exploratory operation the cicatrices were found to be in the duodenum. The patient is now perfectly well. Two cases were complicated by aneurysm of the aorta, 1 of these died from hemorrhage from erosion of a vessel in the gastric ulcer. Two patients had chronic nephritis, and 2 had arthritis deformans. What part these processes played in the etiology is difficult to estimate. There were many other associated conditions (erysipelas, strangulated hernia, pyosalpingitis, etc.). The most important one was typhoid fever, in the course of which sudden pain in the epigastrium and profuse hemorrhage with signs of peritonitis led to an exploration for "perforation," with negative result. One day later, at autopsy, an acute gastric ulcer, with erosion of a vessel, was found.

DURATION AND COURSE. The chronicity of the disease is well recognized. The usually accepted time-limit is from three to five years. Sixty-four of our cases had suffered from periods varying from two months to twenty years, the average being 4.1 years. Cases are on record of longer duration. Thus, Habershon reports a case of forty-six years, and Brinton one of thirty-five years' duration. Lebert found ulcer to be latent in 15 per cent.; of less than one year's duration, 18 per cent.; one to six years, 46.5 per cent.; six to twenty years, 18 per cent.; and twenty to twenty-five years, 2.5 per cent.

TREATMENT. *Medical Treatment.* The treatment followed in the medical wards is similar to that in vogue elsewhere. First of all, absolute bodily rest is insisted upon for a period of from three to six weeks. The stomach is given either complete rest (*i. e.*, rectal feeding for a period varying from five days to two weeks, according to the severity of the case), or partial rest is afforded by the blandest diet—thin soups, whey, milk, etc. Some clinicians, as Fournier, insist upon rectal alimentation for two weeks or even one month. The bowels are regulated, and the anæmia, if present, treated by iron or arsenic. The hyperacidity is counteracted by large doses of carbonate of magnesia, and occasionally by gastric lavage. This latter was instituted in a few cases only, but with marked benefit, even in those without dilatation or obstruction.

Surgical Treatment. The indications for surgical treatment, according to Mayo Robson, are: 1. Perforation. 2. Perigastric adhesions, as pyloric obstruction or hour-glass stomach. 3. Ulcer, intractable to prolonged medical treatment. 4. Recurring and profuse hæmatemesis. 5. Certain cases of acute hæmatemesis.

Let us consider these various indications:

Perforation. All now are agreed upon the advisability of immediate operation for this fatal complication. The great strides that have been made in this branch of surgery are very encouraging. Thus, Weir and Foote, in 1896, gave the mortality in perforation cases treated surgically at 71.5 per cent., while four years later Tinker[20] found that it had dropped to 42.6 per cent.—indeed, in those operated upon in the first twenty-four hours the mortality was only 25 per cent. Mayo Robson[21] in the same year in 429 collected cases found the mortality to be 35 per cent. Brunner,[16] in 1903, gave the mortality as 48 per cent. in gastric and 80 per cent. in duodenal. Of course, statistics collected from literature give an exaggerated idea of the good results of operation, as the majority of the favorable cases are published; nevertheless, the mortality from perforative ulcer is becoming rapidly less—in direct ratio to the number of cases that are early handed over to the surgeon.

Hemorrhage. In this hospital only one case of hemorrhage from gastric ulcer has been treated by the surgeon. This was Case 62 (the typhoid fever patient), who had developed sudden abdominal pain, hemorrhage, and signs of perforation, but in whom the source of the bleeding was, however, not discovered until after death. Dieulafoy[15] advises surgical intervention, if the hemorrhage is as much as half a litre, and *insists* if the bleeding is repeated in twenty-four hours. Moynihan[22] divides the cases into two classes: 1. Acute ulcer, in which operation is *not* indicated except in a few cases where hemorrhage is both copious and recurrent. 2. Chronic ulcer, where operation is indicated in (*a*) a group of cases where bleeding is copious and transient, and (*b*) frequent recurring hemorrhage, which is now and then profuse.

While concurring for the most part with the previous writers we cannot agree with a recent statement[23] that "it would appear justifiable to perform gastroenterostomy in every case of gastric ulcer in which, in addition to the other clinical data, gastric hemorrhage is observed." Rodman collected, in 1900, 32 cases of acute gastrorrhagia, with 40.6 per cent. mortality, and 31 cases of chronic gastrorrhagia, with 19.3 per cent. mortality. Mayo Robson,[21] in 1900, found a mortality of 64.2 per cent. in operative cases, as compared with 5 to 10 per cent. treated medically. Moynihan,[8] in 1904, quotes 1 death in 15 cases treated for acute or recurring hemorrhage (6.6 per cent.). Robson, we believe, takes the more conservative stand when he states that medical and general treatment is successful in arresting hæmatemesis in 93 per cent. of the cases, hence should be given a fair and complete trial for at least a few hours.

In the small number of cases where surgical intervention is advisable, Finney's gastroduodenostomy or a posterior gastroenterostomy seems the operation of choice.

Perigastric adhesions were present in 11 of the 23 gastric cases at autopsy or operation (48 per cent.), and in 3 of the 4 duodenal cases (75 per cent.). According to Robson, these are present in 5 per cent. of all necropsies and in 40 per cent. of gastric ulcer cases. Hale White[25] gives the figure in the latter case at 45 per cent., while Fenwick found the stomach adherent in 46 per cent. White has outlined the points in the diagnosis of this complication. There is present very severe pain, more or less constant, not increased by food, though often paroxysmal, and often persisting for years. Dilatation of the stomach or symptoms of gastric ulcer may or may not be present. Vomiting or emaciation may be absent, as the digestion is good. Local tenderness or even an indefinite mass from matting together of the viscera sometimes occurs. In such cases operative measures should be undertaken. White succeeded in curing 3 out of 5 cases.

COMPARISON BETWEEN SURGICAL AND MEDICAL RESULTS. Hardly a sufficient number of cases treated by surgical interference have been followed for a sufficient period to justify a comparison with the results of medical treatment. Mayo Robson had a mortality in 1901 of 5 per cent; W. J. Mayo, of Rochester, Minnesota, 6.5 per cent.; Peterson and Merchol, 11 per cent. Moynihan, in 1904, among 100 cases treated by gastroenterostomy alone, had a mortality of but 2 per cent. These figures all compare favorably with those resulting from medical treatment, the mortality of which varies between 10 and 20 per cent.

The 82 cases treated in the Johns Hokpins Hospital may be tabulated as follows: died, 24 (29.3 per cent.); well, 14 (17.1 per cent.); improved, 39 (47.6 per cent.); unimproved, 3 (3.6 per cent.); not treated, 2 (2.4 per cent.). The term "well" was applied only to those cases which had been free from all symptoms of ulcer for a sufficient time to warrant the hope that the disease was arrested. The large number of deaths (29.3 per cent.) is difficult to explain until one realizes that 11 of these cases were not treated for the ulcer, but died from some intercurrent affection, the ulcer being recognized only at autopsy. The mortality of 69 treated cases was 13, or 18.8 per cent. Cordier says that ulcer is four or five times more frequent in women than in men, but that the mortality during the latter is much greater. In our series there were 16 deaths among the males to 8 among the females—*i. e.*, the proportion was 2 to 1, which, however, corresponds to the incidence in our series, so that the mortality in both series is practically equal. Of the 58 cases that left the hospital during the past fifteen years we sent out a circular letter and received replies from twenty-six, while eleven letters were returned unclaimed.*

The after-result of these twenty-six for an average period of five years is seen in Table IV.:

TABLE IV.

At discharge.		At an average of 5 years.			
		Recurrence.	Death.	Well.	Total.
Died,	24 = 29.3 per ct.	0	0	0	0
Well,	14 = 17.1 "	4	2	5	11
Improved,	39 = 47.6 "	3	4	8	15
Unimproved,	3 = 3.6 "	0	0	0	0
Not treated,	2 = 2.4 "	0	0	0	0
Total,	82	7	6	13	26

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* CIRCULAR LETTER.

DEAR ....

We are interested to know what your condition has been since discharge from the hospital in . Will you kindly answer the following questions:

1. Pain in stomach, if any?
    a. Location.
    b. Character of pain.
    c. Relation to food.
2. Vomiting, if any?
    a. Amount, large or small.
    b. Vomiting of blood, quantity, dark or bright.
3. Passage of blood in stools?
4. Have you been in any hospital since discharge from Johns Hopkins? if so mention hospital and about date of admission.
5. If patient be dead will nearest relative kindly report from what cause and under whose care (physician or hospital)? Were symptoms of stomach trouble still present?

Yours truly,

....

In other words, of 26 patients since discharge there have been 6 deaths (23 per cent.), 7 recurrences (26.8 per cent.), and 13 permanent cures (50 per cent.) for periods ranging from six months to thirteen years. Of the 6 deaths, the cause was gastric in 2, non-gastric in 2, and unknown in 2. Greenough and Joslin publish 55 per cent. cured, 25 per cent. relieved, 13 per cent. dead, and 6 per cent. otherwise at discharge. Their after-results are seen in Table V.:

TABLE V.—GREENOUGH AND JOSLIN'S 114 CASES.

	At discharge.	Recurrence.	Death.	Cure.	Total.
Cured,	63 = 55 per ct. . .	28	8	27	63
Relieved,	29 = 25 " . .	10	4	15	29
Deaths,	15 = 13 " . .	...	...	...	15
Otherwse,	7 = 6 " . .	3	3	1	7
Total,	114	41	15	43	114

The latter table shows recurrence in 50 per cent. as compared with 85 per cent. of Welch, 74 per cent. of von Leube, 75 per cent. of Ewald, and 50 per cent. of Debove.

Russel,[25] of Birmingham, followed the after-history of 63 cases in females, and found that after a period of two years there was a direct mortality in 2.1 per cent. Recovery in 42.6 per cent. and recurrence in 44.7 per cent. Schulz[27] followed 88 cases of ulcer treated medically, in all of which hæmatemesis was present, and found that there were 9 per cent. deaths and only 64 per cent. permanent cures.

Of our 58 cases of gastric ulcer that received medical treatment, 11 were discharged well, 38 improved, 3 unimproved, and 5 dead—*i. e.*, a mortality of only 8.6 per cent. Eleven cases have been transferred for operation, which is too small a number for comparison with the above.

MORBID ANATOMY. For observation we had 23 cases at autopsy and 4 at operation. 23 were gastric and 4 duodenal.

CONDITION OF THE ULCER. The ulcer was more or less active in 19 cases of gastric ulcer and 3 of duodenal. Cicatrization had occurred in 3 gastric and 1 duodenal. In 1 case the condition of the gastric ulcer was not stated. That is to say, there were 22 ulcers to 4 scars—a ratio of about 5.5 to 1, rather contrary to Welch, who considers that the scar is at least twice as frequent as open ulcer.

As to the *number*. In 20 cases—16 gastric and 4 duodenal—there was but one ulcer; in 1 case there were two ulcers; in 1 three ulcers, and in 3 (11.1 per cent.) there were several ulcers. Brinton believes that multiple ulcers are found in 20 per cent.

The particulars as to the site, presence of adhesions, local or general peritonitis, etc., are given in detail under the various clinical sections.

CONCLUSIONS. 1. Gastric ulcer is rare in the Johns Hopkins Hospital as compared with cancer, the respective incidences being 1 to 225 and 1 to 56 general admissions.

2. Gastric ulcer in our series was as common in the male as in the female. In the male the percentage of greatest frequency was between the ages of forty and fifty—a decade later than usual.

3. Ulcer was in our cases relatively more frequent in the colored race and among Germans.

4. Vomiting occurred in 85.3 per cent.; pain in 82.9 per cent., and hæmatemesis in 75.6 per cent.

5. Great loss of weight may be present; thus, in 36 cases there was a loss of more than ten pounds, and in 9 of forty pounds or more.

6. Our statistics would indicate that hyperchlorhydria is not so constant as usually maintained; it was present in only 17.6 per cent. of our cases.

7. The blood picture is one of chloranæmia as seen from the average count (hæmoglobin, 58 per cent.; red blood corpuscles, 4,071,000; white blood corpuscles, 7500 per c.mm.).

8. Hemorrhage was the cause of death in 8.5 per cent. of the total number of cases, and in 29.5 per cent. of the fatal cases.

9. Perforation is rare (3 cases, or 3.6 per cent. of our series). General peritonitis occurred in but one instance (1.2 per cent.).

10. Ulcus carcinomatosum is rare—at least 4.8 per cent. of our series.

11. Operation is indicated in all cases with perforation or perigastric adhesions, and in cases of copious or recurring hemorrhage, when medical means have failed after a fair trial.

12. The mortality of the series was 29.3 per cent.; in the cases, however, who received treatment there was a mortality of only 18.8 per cent.; in those receiving medical treatment alone, 8.6 per cent.

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INTERMITTENT HYPERCHLORHYDRIA AS AN OCCASIONAL CAUSE OF RECURRENT VOMITING IN CHILDREN.

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THE object of this paper is to direct attention to the curious symptom-complex called cyclic, periodical, or, better, recurrent vomiting of children, with the idea (1) that the condition is not as rare as is generally supposed; (2) that it is relatively easy of diagnosis, an examination of the vomited matter being most important; (3) that at least in some cases the gastric irritability is due to an intermittent hyperchlorhydria, a secretory neurosis, causing the sudden hypersecretion of free HCl and gastric juice.

Vomiting is the main symptom of the malady. The subject, except for the attacks, is in perfect health. The vomiting attacks occur at irregular intervals, begin with slight premonition, continue usually a few days, and cease suddenly, leaving the patient with an unimpaired appetite and digestion.

A similar group of symptoms has long been recognized in adults. In mature life gastric pain is a most prominent feature, while children suffer more from nausea.

The condition in children was first recognized by American authors, although a suggestion as to its existence was first published by Gee. In 1893 I attended a little girl who was harassed by repeated and dangerous attacks of vomiting, lasting several days, and appearing without adequate exciting cause or dietetic error. I reported the case, under the title of "A Gastric Neurosis in Childhood," to the American Pediatric Society. An interesting discussion followed, showing that many of the members had seen these repeated prostrating attacks of vomiting, that they did not consider them ordinary gastric indigestion or gastritis, as they appeared suddenly in children with normal digestion, carefully fed, and the illnesses terminated abruptly, and were separated by intervals of perfect health.

Since then numerous cases of recurrent vomiting have been reported, and the condition is mentioned in most English and Amer-